Landsat 7 Processing System (LPS) Build Implementation Plan

April 1996

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

Landsat 7
Processing System (LPS)
Build Implementation Plan

April 1996

Prepared by:

4/15/96
Dennis Crehan Date
Systems Engineer
Landsat 7 Processing System
SEAS
Loral AeroSys

Concurred by:

April 16, 96
Robert Schweiss Date
Systems Engineering Manager
Landsat 7 Processing System
Code 514
Goddard Space Flight Center

Approved by:

4/15/96
Daniel Ferry Date
Software Task Leader
Landsat 7 Processing System
SEAS
Computer Sciences Corporation

Approved by:

4/18/96
Jeffrey Hosler Date
Software Engineering Manager
Landsat 7 Processing System
Code 514
Goddard Space Flight Center

Approved by:

4/15/96
Michael Andrews Date
Project Manager
Landsat 7 Processing System
SEAS
Computer Sciences Corporation

Approved by:

4/18/96
Joy Henegar Date
Project Manager
Landsat 7 Processing System
Code 514
Goddard Space Flight Center

Abstract

This document contains the software build implementation plan for the Landsat 7 Processing System (LPS). The allocation of software to builds is based on an analysis of the requirements contained in the LPS Functional and Performance Specification (F&PS) and the LPS Operations Concept documents. The software available for reuse from prior development, including LPS prototypes, and the sizing of new development were also considered in allocating software to builds.

Keywords:

Landsat 7
Landsat 7 Processing System (LPS)
Landsat 7 Ground Station (LGS)
Landsat Processes Distributed Active Archive Center (LP DAAC)
Functional and Performance Specification (F&PS)
Mission Operations and Data Systems Directorate (MO&DSD)
Systems Management Policy (SMP)
Mission Operations and Systems Development Division (MOSDD)

Preface

This document contains the build implementation plan for the LPS software. The implementation is based on information contained in the LPS Functional and Performance Specification (F&PS), the LPS System Design Specification, the LPS Operations Concept document, the LPS Software Requirements Specification, and the LPS Detailed Design Specification.

This build implementation plan was prepared by:

Landsat 7 Processing System Project
Code 514
Goddard Space Flight Center
Greenbelt, MD 20771

Table of Contents

SECTION 1 -- INTRODUCTION

1.1 Scope....1-1
1.2 Reference Documents....1-1

SECTION 2 --- OVERVIEW

2.1 LPS Overview....2-1
2.2 Build Process....2-1

SECTION 3 --- BUILD PLAN

3.1 Build/Release Capabilities and Rationale....3-1
3.2 LPS Build Schedule....3-5
3.3 Resources Required....3-5
3.3.1 LPS System Hardware....3-6
3.3.2 Test Tools and Data....3-9
3.3.3 Commercial Off-the-Shelf Software (COTS)....3-9

Appendix A — Mapping of Requirements to Builds

Appendix B — Development Area Lines of Code Estimates

Appendix C — Mapping of Units to Builds

SECTION 1 -- INTRODUCTION

1.1 Scope

This build/release plan documents the approach used by the Mission Operations and Systems Development Division (MOSDD) of the Mission Operations and Data Systems Directorate (MO&DSD) at Goddard Space Flight Center (GSFC) in implementing the subsystems of the Landsat 7 Processing System (LPS). It describes the build methodology that will be used to implement the subsystem capabilities, provides the detailed build/release functional contents, and maps the requirements and units to the various builds/releases. The implementation schedule is based in part on the requirements for the LPS to support the Landsat 7 Ground System test schedules.

1.2 Reference Documents

The following documents contain background and/or detailed information which was referenced in creating the LPS Build Implementation Plan.

1. NASA GSFC/MO&DSD, Landsat 7 Processing System (LPS) Functional and Performance Specification, Revision 1, 560-8FPS/0194, July 14, 1995

2. NASA GSFC/MO&DSD, Landsat 7 Processing System (LPS) Operations Concept, Revision 1, 560-30CD/0194,July 14, 1995

3. NASA GSFC/MO&DSD, Landsat 7 Processing System (LPS) System Design Specification, 560-8SDS/0194, May 26, 1995

4. NASA GSFC/MO&DSD, Landsat 7 Processing System (LPS) Software Requirements Specification, 560-8SWR/0195, April 28, 1995

5. Wayne Gustafson (NASA), L-7 Ground System Master Schedule, September 15, 1995

6. EOSDIS Core System Project, Science Data Processing Segment (SDPS) Integration and Test Plan for the ECS Project Volume 2: Release A 319-CD-005-002, March 1995

7. NASA GSFC/MO&DSD, Landsat 7 Processing System (LPS) System Integration and Test Plan, 514-2ITP/0195, October 1995

8. NASA GSFC/MO&DSD, Landsat 7 Processing System (LPS) Detailed Design Specification, 514-4DDS/0195, October 1995

SECTION 2 --- OVERVIEW

2.1 LPS Overview

The LPS is a major component of the Landsat 7 system and is located, along with the Landsat 7 Ground Station (LGS) and the Land Processes Distributed Active Archive Center (LP DAAC), at the Earth Resources Observation System (EROS) Data Center (EDC). The LPS coordinates its operations with the LGS in accordance with the Landsat 7 contact period schedules to receive the return link wideband data in real-time from all four output channels of the LGS into its four wideband data stores, one per LPS string. Each LPS string retrieves the received wideband data from its wideband data store and processes it at a rate equal to or greater than 7.5 Mbps, generates Level 0R, browse, and metadata files (collectively called the LPS files), and makes the LPS files available for transfer to the LP DAAC. The LPS also generates return link data quality and accounting information from the wideband data received on a Landsat 7 contact period basis and provides that information as part of the metadata to the LP DAAC. LPS receives the equivalent of 250 ETM+ scenes of wideband data from LGS, saves the data in 30-day storage, processes the data to LPS files, and provides the files to LP DAAC on a daily basis. The LPS also provides a fifth spare string to be used as backup for any one of its four primary strings.

2.2 Build Process

The LPS will be implemented in three incremental builds. Build 1 software is implemented and tested through verification of system requirements but not formally released to the customer. Each subsequent build consists of the new functionality assigned to that build plus the software from the previous build. LPS Release 1 combines Build 1 and Build 2 software for factory acceptance and operational testing; Build 3/Release 2 software completes the LPS as defined in the system requirements.

SECTION 3 --- BUILD PLAN

3.1 Build/Release Capabilities and Rationale

LPS implementation is performed in three builds and two releases. Table 3-1 summarizes the functions developed in each build and release. Appendix A maps requirements to builds. Appendix B lists the lines of code estimates for each build. Appendix C maps units to builds.

Build 1 supports instrument integration and test; Build 2/Release 1 supports spacecraft integration and test and external interfaces, including the IAS and the LP DAAC; Build 3/Release 2 satisfies all LPS system level requirements.

Build 1 provides raw data handling, including subinterval determination, and limited operator support in the form of status and error messages. The LPS interface with the LGS is available for manual data capture; the electronic interface with LP DAAC is not available. Sample DAN files can be transmitted for testing via FTP. Development of the more complex tasks defined for level 0R processing begins in Build 1. Status and error monitoring functions are available in LPS Build 1 software to aid in the assessment of test results. Files are created by the LPS, but the contents are not fully processed to the point of Landsat 7 Level 0R data.

In Build 2/Release 1 the more complex tasks of major frame processing and Payload Correction Data (PCD) processing are implemented, and image data processing is complete except for the moving window display. Release 1 provides the capability to generate Level 0R image data and support files and transmit them to the LP DAAC. It provides an end-to-end working system, although some functions are invoked from the command line instead of via the operator GUI. Build 2/Release 1 includes implementation of approved Configuration Change Requests (CCRs) for problem resolution or design changes. Release 1 is the first release delivered to EDC for factory acceptance testing.

Software prototyped for the LPS or reused from previous development (e.g., BCH, CRC, Reed-Solomon error detection and correction; automatic cloud cover assessment; frame synchronization; DAAC electronic interface) is incorporated in the first two builds.

Build 3/Release 2, the final release of the LPS, incorporates threshold handling in the data processing, completes the metadata generation, provides all expected output data files, reprocesses data stored on

tape, and generates reports from the user interface. All approved CCRs are implemented, and all LPS requirements are satisfied by the completion of Build 3 implementation.

Table 3-1. Function Allocation Per Build/Release (1 of 4)

	BUILD 1	BUILD 2 / REL 1	BUILD 3 / REL 2
General		Approved enhancements and problem correction	Approved enhancements and problem correction
	Common Basic Database Routines		
		Common Database Subinterval Information Extraction	
	Log Message Routines		
	Common Process Routines		
		Common FIFO Routines	
	Common Shared Memory Routines		
	Common Semaphore Routines		
	Common Time Routines		
User Interface			Raw Data Capture Forms
			Level 0R Processing Forms
		Modify LPS Configuration Table Form	
		Modify LPS Parameters Tables Form	
			Modify LPS Thresholds Tables Form
			Data Receive Summary Form
			LPS Processing Q/A Form
			Data Transfer Summary Form
			Manage Files Form
			Control DAN Transfer Form
Database	Table/Script Generation		
		Indexing	

		Triggers	

Table 3-1. Function Allocation Per Build/Release (2 of 4)

	BUILD 1	BUILD 2 / REL 1	BUILD 3 / REL 2
Database (continued)			Performance
			Fine Tuning
Management and Control	Control Level 0R Processing		
			Generate Metadata
			Generate LPS Processing Q/A Report
			Automatic Data Capture
			Ingest Capture Schedules
			Ingest IAS Parameters
Raw Data Capture	Receive Raw Wideband Data		
			Restage Raw Wideband Data
			Save Raw Wideband Data
		Delete Raw Wideband Data	
			Generate Data Receive Summary Report
			Data Transmit (Test)
		Update RDCS Accounting Table	
			Generate Tape Labels
		Receive Raw Wideband Parameters	
Raw Data Processing	Perform SCLF CADU Sync		
	Align Bytes		
	Deinvert Data		
	Perform PN Decode		
	Perform CRC Check		
	Perform RS EDAC		
	Identify Fill CADUS		
	BCH EDAC		
	Detect VCID Change		
	Failed CADU Trouble File		
		CCSDS Parameters	

			RDP Thresholds
Major Frame Processing	Identify VCDUs		
		Extract PCD Bytes	

Table 3-1. Function Allocation Per Build/Release (3 of 4)

	BUILD 1	BUILD 2 / REL 1	BUILD 3 / REL 2
Major Frame Processing (continued)	Identify Major Frame		
	Extract Major Frame Time		
	Determine Subintervals		
	Collect Quality and Accounting		
		Deinterleave and Reverse Bands	
		Align Bands	
	Create MSCD File		
		Create Calibration File	
		Sensor Alignment/MFP Parameters	
			MFP Thresholds
Payload Correction Data Processing		Extract Information Word	
		Determine Majority Vote Word	
		Assemble Minor Frames	
		Assemble Major Frames	
		Build PCD Cycle	
		Create PCD File	
		Determine Scenes	
		Report Scene Information	
			Report Bands Present
		PCD/Scene Parameters	
			PCD Thresholds
Image Data Processing		Reduce Image by Subsamples	
		Reduce Image by Wavelets	
		Report Browse Information	
		Generate Browse File	

		Report Band Information	
		Generate Band File	

Table 3-1: Function Allocation Per Build/Release (4 of 4)

	BUILD 1	BUILD 2 / REL 1	BUILD 3 / REL 2
Image Data Processing (continued)		Generate Cloud Cover Assessment	
		Report Cloud Cover Assessment	
		Band Parameters	
			Moving Window Display
LPS Data Transfer	Generate DAN		
		Transmit DAN	Transmit Suspended DANs
		Receive DDN	Timeout on DDN
		Process DDN	
		Send DDA	
		Receive DAA	
		Delete Output Files	
		Mark Output Files for Retention	
			Generate Transfer Summary Report

Verification of LPS performance requirements is addressed early in the development life cycle. The implementation planned for LPS allows for some verification of performance requirements starting with Build 1 at the module test level. Performance testing continues throughout Build 2/Release 1 and in Build 3/Release 2 the system meets all LPS system level performance requirements.

3.2 LPS Build Schedule

Table 3-2 is the LPS schedule from the beginning of Build 1 implementation through LPS site installation at EDC.

3.3 Resources Required

This section describes the system hardware, test resources, and allocation of major COTS software for the LPS implementation.

Table 3-2: LPS Implementation Schedule

Scheduled Start	Scheduled Finish	Description
11/01/95	04/26/96	Build 1 Implementation
04/29/96	06/28/96	Build 1 System Test
04/01/96	08/31/96	Build 2 Implementation
09/02/96	10/30/96	Build 2 System Test
09/02/96	01/31/97	Build 3 Implementation
11/01/96	11/01/96	Release 1
02/03/97	03/30/97	Build 3 System Test
03/31/97	04/01/97	Release 2
04/02/97	05/15/97	Factory Acceptance Test
06/15/97	06/15/97	EDC Site Installation

3.3.1 LPS System Hardware

Figure 3-1 shows the LPS hardware development environment, including those elements resident at GSFC and those resident at the SEAS Greentec IV facility.

Figure 3-2 shows the allocation timeline for the major LPS system hardware during development and system test. This allocation assumes that the additional three SGI Challenge XL computers will not be made available for development or testing until at the earliest the end of Build 2/Release 1. At that time they can be used for system testing and/or acceptance testing.

Figure 3-2 shows how the various development and test activities overlap and how the hardware is allocated to the development team, the hardware prototype effort, and system test (which in this context includes formal CM). The intent of this allocation is to provide ample resources for developers while providing sufficient resources for hardware prototyping, system testing, and acceptance testing (TBD).

LPSDEV1 (Challenge XL) is allocated for software development but will be used as the transmission source for data capture during Build1 system testing. LPSDEV2 (Challenge L) is allocated for software development throughout the entire development process. The allocation of LPSDEV2 for CM libraries and software development is based on the assumption that this computer will be physically resident at the SEAS Greentec IV facility. LPSDEV3 (Challenge XL with dual VME) is allocated for hardware prototyping and for system test until the end of Build 2. At that time it can be

used for software development or system testing as needed, with any additional hardware prototyping occurring on a scheduled basis.

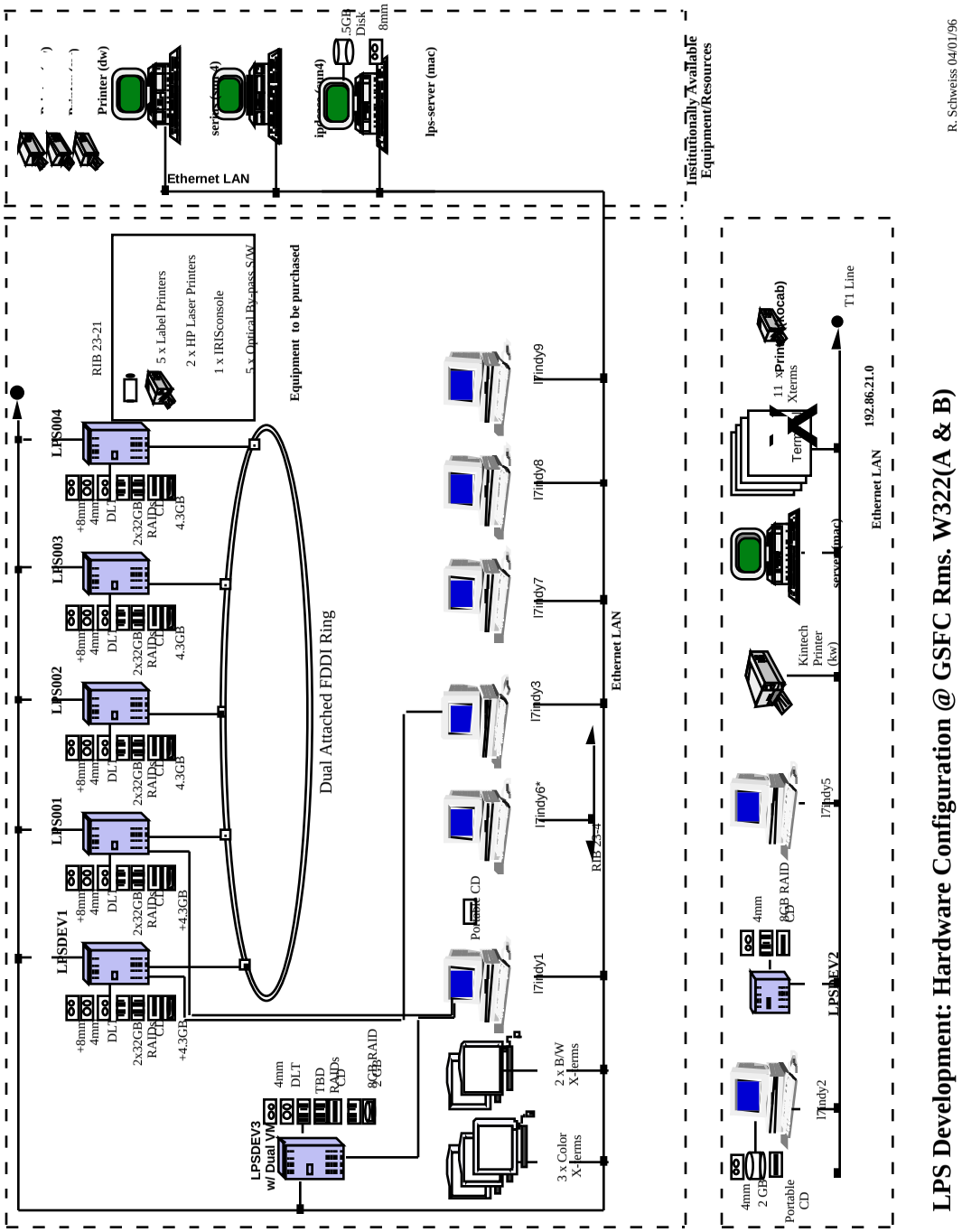

Figure 3-1. Development Environment

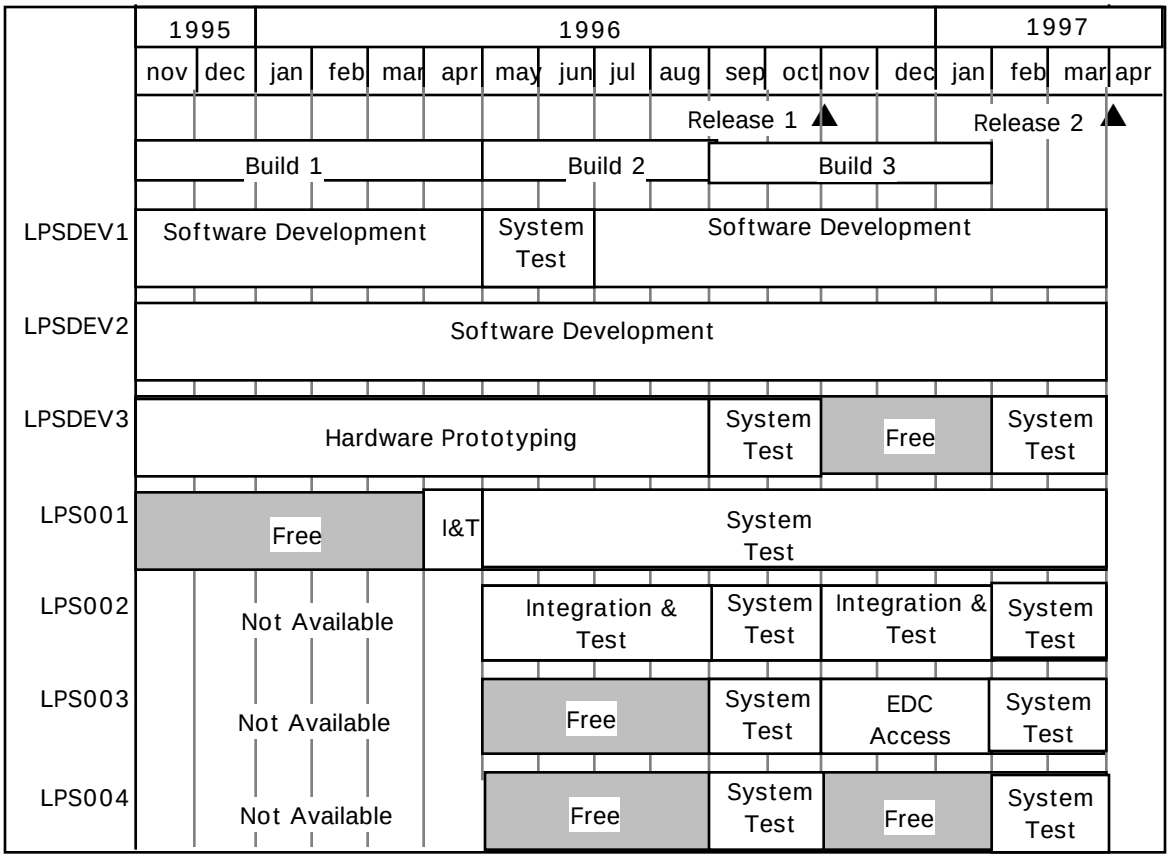

Figure 3-2: LPS Hardware Allocation Timeline

LPS001 (Challenge XL) is allocated for system test throughout the development and system testing process. LPS002 is allocated for integration and test except when required for system test. LPS003 is allocated for system test and for EDC access to LPS Release 1 software prior to Build 3 system test. At other times it is available. LPS004 is allocated for system test. At other times it is available.

At least two strings are necessary to test raw data capture: one to send the data and the second to receive the data with the Raw Data Capture Subsystem (RDCS). During Build 1, since only a limited number of Challenge XL computers are available, software personnel, system test personnel, and hardware prototyping personnel must coordinate to test raw data capture.

The LPS hardware must be accessible to the implementation and test teams 24 hours a day, 7 days a week. Access on evenings and weekends will be provided via a small number of keys. Development terminals, printers and network connections must be available to the LPS team members at the SEAS Greentec IV facility and at GSFC.

3.3.2 Test Tools and Data

Raw wideband data will be provided by the Generic Telemetry SIMulator (GTSIM) for both nominal and limited data error conditions. A test tool will be developed by the LPS team to modify data to insert errors outside the scope of GTSIM production. Additional Landsat 7 data will be available from spacecraft and instrument tests. Data containing fill in critical areas (PCD, time codes) will require a tool to insert valid data in place of fill.

Test drivers/stubs will be written to simulate subsystem processes not implemented in Build 1; tools to dump data from shared memory and to produce formatted dumps of LPS files will also be developed.

In addition to interface testing with external facilities, tests will be run with interface simulators to eliminate schedule dependency on external Landsat 7 ground system elements.

Tools and data should be available for Build 1 testing. Both will be used for unit, module, subsystem and system test, and may be provided to the customer for acceptance and operational test use.

Test tools and data are addressed in more detail in the Landsat 7 Processing System (LPS) Integration and Test Plan.

3.3.3 Commercial Off-the-Shelf Software (COTS)

Table 3-3 allocates COTS licenses across the development computers. The allocation is based on the assumption that the Challenge L computer will be physically resident at the SEAS Greentec IV facility. The late-arriving Challenge XL computers have not been allocated any COTS licenses. This decision will be revisited when the computers are available for use.

Table 3-3: COTS License Allocation

Computer	Oracle	CaseVision Workshop
LPSDEV1	8	8
LPSDEV2	13	18
LPSDEV3	2	1
LPS001	1	0
LPS002	0	0
LPS003	0	0

LPS004	0	0
Total	24	27

Appendix A — Mapping of Requirements to Builds

The following table maps the LPS functional (F&PS) requirements to the LPS software requirements and the builds in which the requirements are satisfied (fully testable by System Test). Some F&PS requirements are system level requirements and are therefore not mapped to software requirements. F&PS requirements that should be mapped to software requirements but are not currently mapped are designated To Be Mapped (TBM).

LPS F&PS Requirement Number	LPS Software Requirement Number	LPS Software Requirement Name	Build
3.1. 4	2.2	Synchronize CCSDS Frame	1
3.1. 4	2.3	Process CCSDS Grade 3	1
3.1. 4	2.4	Decode BCH	1
3.1. 4	2.5	Annotate VCID Change	1
3.1. 4	2.7	Generate Return Link QA Report	3
3.1. 5	5.2.1	Reduce Image by Subsamples	2
3.1. 5	5.2.2	Reduce Image by Wavelets	2
3.1. 5	5.3	Generate Band File	2
3.1. 5	6.2	Generate Metadata	3
3.1. 6	2.4	Decode BCH	1
3.1. 6	2.7	Generate Return Link QA Report	3
3.1.7	3.7	Generate Level 0R QA Report	3
3.1. 8	6.1	Process LPS Directive	3
3.1.10	6.7	LPS System Control	1
3.1.10.1	6.7	System Start-up	1
3.1.10.2	TBM	System Shut-down	1
3.1.10.3	2.4	Decode BCH	1
3.1.10.4	6.8	Monitor System Faults	1
3.1.10.5	6.8	Monitor System Faults	1
3.1.11	2.2	Synchronize CCSDS Frame	1
3.1.11	6.1	Process LPS Directive	1
3.1.12	2.4	Decode BCH	1
3.1.14	6.5	Modify LPS Configuration	2
3.1.19	6.3	Report LPS Status	1
3.2.1	TBM	Interface with LGS	1
3.2.2	7.2	Send DAN	2
3.2.2	7.4	Transfer Files	2

3.2.3		Interface with MOC	
3.2.4	6.1	Process LPS Directive	1
LPS F&PS Requirement Number	**LPS Software Requirement Number**	**LPS Software Requirement Name**	**Build**
3.3.1. 1	1.1	Receive Raw Wideband Data	1
3.3.1. 2	1.1	Receive Raw Wideband Data	1
3.3.1. 3	1.1	Receive Raw Wideband Data	1
3.3.1. 4	1.1	Receive Raw Wideband Data	1
3.3.1.5	TBM	Retrieve Raw Wideband Data on a Contact Period Basis	3
3.3.1.6	TBM	Retrieve Raw Wideband Data on an Output Channel Basis	3
3.3.1.7	1.2	Record Raw Wideband Data	3
3.3.1.8	1.2	Save Raw Wideband Data	3
3.3.1.9	1.3	Restage Raw Wideband Data	3
3.3.1.10	TBM	Generate Raw Data Receive Summary	3
3.3.1.11	Operator	Coordinate Raw Data Receipt	
3.3.1.12	1.1	Receive Raw Wideband Data	1
3.3.2.1	2.3.1	Perform CRC Check	1
3.3.2.1	2.3.2	Perform RS-EDAC Check	1
3.3.2.1	2.3.3	Discard Fill CADUs	1
3.3.2.2	TBM	Perform CADU Sync	1
3.3.2.3	2.2.1	Perform SCLF Sync	1
3.3.2.3	2.2.2	Align Bytes	1
3.3.2.3	2.2.3	Deinvert Data	1
3.3.2.4	2.2.1	Perform SCLF Sync	1
3.3.2.5	2.2.3	Deinvert Data	1
3.3.2.6	2.2.1	Perform SCLF Sync	1
3.3.2.7	2.2.4	Perform PN Decode	1
3.3.2.8	2.3.1	Perform CRC Check	1
3.3.2.8	2.3.2	Perform RS-EDAC Check	1
3.3.2. 9	2.4	Decode BCH	1
3.3.2. 9.1	2.4	Decode BCH	1
3.3.2.10	2.4	Decode BCH	1
3.3.2.11	2.5	Annotate VCID Change	1
3.3.2.11	3.4.4	Determine Subintervals	1
3.3.2.12	TBM	Delete Fill VCDUs	1
3.3.2.13	2.4	Decode BCH	1
3.3.2.14	3.4.1	Identify Major Frames	1
3.3.2.15	3.4.1	Identify Major Frames	1
3.3.2.16	3.5.1	Deinterleave and Reverse Bands	2

3.3.2.17	3.5.1	Deinterleave and Reverse Bands	2
LPS F&PS Requirement Number	**LPS Software Requirement Number**	**LPS Software Requirement Name**	**Build**
3.3.2.18	3.5.1	Deinterleave and Reverse Bands	2
3.3.2.19	3.5.1	Deinterleave and Reverse Bands	2
3.3.2.20	3.6.3	Extract MSCD Data	1
3.3.2.21	3.6.4	Extract Calibration Data	2
3.3.2.22	3.5.2	Align Bands	2
3.3.2.23	3.4.4	Determine Subintervals	1
3.3.2.24	3.5.1	Deinterleave and Reverse Bands	2
3.3.2.24	5.3	Generate Band File	2
3.3.2.25	5.2.1	Reduce Image by Subsamples	2
3.3.2.25	5.2.2	Reduce Image by Wavelets	2
3.3.2.25	4.6	Create PCD File	2
3.3.2.25	5.3	Generate Band File	2
3.3.2.25	3.6.1	Create MSCD File	1
3.3.2.25	3.6.3	Extract MSCD Data	1
3.3.2.26	3.2	Identify VCDUs	1
3.3.2.26	3.4.4	Determine Subintervals	1
3.3.2.28	5.3	Generate Band File	2
3.3.2.29	4.4.1	Compute Position MJF Time	1
3.3.3.1	5.2.1	Reduce Image by Subsamples	2
3.3.3.1	5.2.2	Reduce Image by Wavelets	2
3.3.3.3	5.2.1	Reduce Image by Subsamples	2
3.3.3.3	5.2.2	Reduce Image by Wavelets	2
3.3.3.4	5.2.1	Reduce Image by Subsamples	2
3.3.3.5	5.2.1	Reduce Image by Subsamples	2
3.3.3.5	5.2.2	Reduce Image by Wavelets	2
3.3.4. 1	4.2.1	Extract Info Word	2
3.3.4. 2	3.3	Extract PCD	2
3.3.4. 2	4.3.1	Assemble Minor Frames	2
3.3.4. 2	4.3.2	Assemble Major Frames	2
3.3.4. 3	4.3.2	Assemble Major Frames	2
3.3.4. 4	4.6	Create PCD File	2
3.3.4. 5	4.3.3	Build PCD Cycles	2
3.3.4. 5	4.6	Create PCD File	2
3.3.4. 7	4.4.3	Determine WRS Scene Coordinates	2
3.3.4. 8	5.4.1	Collect Scene Data	2

3.3.4. 8	5.4.2	Generate Cloud Cover Assessment	2
LPS F&PS Requirement Number	**LPS Software Requirement Number**	**LPS Software Requirement Name**	**Build**
3.3.4. 9	5.4.2	Generate Cloud Cover Assessment	2
3.3.4.10	5.4.2	Generate Cloud Cover Assessment	2
3.3.4.11	6.2	Generate Metadata	3
3.3.4.12	6.2	Generate Metadata	3
3.3.4.13	6.2	Generate Metadata	3
3.3.4.14	6.2	Generate Metadata	3
3.3.4.15	6.2	Generate Metadata	3
3.3.4.16	6.2	Generate Metadata	3
3.3.5.1	7.2	Send DAN	2
3.3.5.2	7.4	Transfer Files	2
3.3.5.3	7.3	Receive DTA	2
3.3.5.4	7.6	Delete LPS Files	2
3.3.5.4	7.7	Retain LPS Files	2
3.3.5.5	7.6	Delete LPS Files	2
3.3.5.6	7.7	Retain LPS Files	2
3.3.5.7	7.5	Generate Transfer Summary Report	3
3.3.6. 1	6.1	Process LPS Directive	3
3.3.6. 1	6.6	Modify Contact Schedule	3
3.3.6. 2	2.4	Decode BCH	1
3.3.6. 2	2.7	Generate Return Link QA Report	3
3.3.6. 3	6.1	Process LPS Directive	3
3.3.6. 3	6.4	Display or Print LPS Report	3
3.3.6. 4	6.1	Process LPS Directive	3
3.3.6. 4	6.4	Display or Print LPS Report	3
3.3.6. 5	6.1	Process LPS Directive	3
3.3.6. 5	6.4	Display or Print LPS Report	3
3.3.6. 6	4.3.1	Assemble Minor Frames	2
3.3.6. 6	5.4.1	Collect Scene Data	2
3.3.6. 6	5.4.2	Generate Cloud Cover Assessment	2
3.3.6. 6	6.1	Process LPS Directive	3
3.3.6. 7	4.3.1	Assemble Minor Frames	2
3.3.6. 7	5.4.1	Collect Scene Data	2
3.3.6. 7	5.4.2	Generate Cloud Cover Assessment	2

3.3.6. 8	1.1	Receive Raw Wideband Data	1
3.3.6. 8	2.2	Synchronize CCSDS Frame	1
3.3.6. 8	6.1	Process LPS Directive	3
LPS F&PS Requirement Number	**LPS Software Requirement Number**	**LPS Software Requirement Name**	**Build**
3.3.6. 8	7.6	Delete LPS Files	3
3.3.6. 8	7.7	Retain LPS Files	3
3.3.6. 9	1.1	Receive Raw Wideband Data	1
3.3.6. 9	2.2	Synchronize CCSDS Frame	1
3.3.6. 9	6.1	Process LPS Directive	3
3.3.6. 9	6.7	LPS System Control	3
3.3.6. 10	TBM	Moving Window Display	3
4.1. 6	2.2	Synchronize CCSDS Frame	3
4.1. 6	2.3	Process CCSDS Grade 3	1
4.1. 6	2.4	Decode BCH	1
4.1. 6	2.5	Annotate VCID Change	1
4.1. 6	2.7	Generate Return Link QA Report	3
4.3.3	2.2	Synchronize CCSDS Frame	1
4.3.4	5.2.1	Reduce Image by Subsamples	2
4.3.4	5.2.2	Reduce Image by Wavelets	2
4.3.5	4.4.3	Determine WRS Scene Coordinates	2

Appendix B — Development Area Lines of Code Estimates

	Est LOC	B1	B2	B3
Analysis Tools	9300	3715	4715	870
Database	1300	500	400	400
Globals	7650	5460	2190	0
RDCS	4200	1320	1380	1500
RDPS	6750	6420	150	180
MFPS	8400	5955	2085	360
PCDS	7950	0	7410	540
IDPS	7000	0	6000	1000
MACS	7500	2370	150	4980
LDTS	7350	750	4200	2400
Net Total	67400	26490	28680	12230
CCRs (20%)	11034		5298	5736
Total	**78434**	**26490**	**33978**	**17966**
		34%	43%	23%

Appendix C — Mapping of Units to Builds

Table C-1: Global Units-to-Build Mapping (1 of 2)

	B1	B2	B3
lps_CaptureIsRunning	100%		
lps_db_Commit	100%		
lps_db_Connect	100%		
lps_db_Disconnect	100%		
lps_db_ErrorMessage	100%		
lps_db_GetLPSConfiguration	100%		
lps_db_GetSubIntvInfo		100%	
lps_db_InsertFileInfo	100%		
lps_db_Rollback	100%		
lps_FIFOClose		100%	
lps_FIFOCreate		100%	
lps_FIFOOpen		100%	
lps_FIFOReceive		100%	
lps_FIFORemove		100%	
lps_FIFOSend		100%	
lps_FileNameCreate	100%		
lps_LogMessage	100%		
lps_ProcessChildStatus	100%		
lps_ProcessInit	80%	20%	
lps_ProcessStartChild	100%		
lps_RsrcAlloc	80%	20%	
lps_RsrcAllocFIFO		100%	
lps_RsrcAllocShm	100%		
lps_RsrcDealloc	80%	20%	
lps_ShmAddListTail	100%		
lps_ShmClose	100%		
lps_ShmComputeSize	100%		
lps_ShmCreate	100%		
lps_ShmCreateSemaphore	100%		
lps_ShmGetRdBlk	100%		
lps_ShmGetWrBlk	100%		
lps_ShmOpen	100%		
lps_ShmOpenSemaphore	100%		

Table C-1: Global Units-to-Build Mapping (2 of 2)

	B1	B2	B3
lps_ShmPutRdBlk	100%		
lps_ShmPutWrBlk	100%		
lps_ShmRemListHead	100%		
lps_ShmRemListTail	100%		
lps_ShmRemove	100%		
lps_TimeAdd	100%		
lps_TimeCompare	100%		
lps_TimeDiff	100%		
lps_TimeDivide	100%		
lps_TimeGetCurrentTime	100%		
lps_TimeString2Struct	100%		
lps_TimeStruct2String	100%		

Table C-2: Database Units-to-Builds Mapping

	B1	B2	B3
Table/Script Generation	100%		
Indexing		100%	
Triggers		100%	
Performance			100%
Fine Tuning			100%

Table C-3: MACS Units-to-Builds Mapping (1 of 2)

	B1	B2	B3
mac_ACAcceptSignal			100%
mac_ACSleep			100%
mac_AutoCapture			100%
mac_db_ACGetNextCaptureInfo			100%
mac_db_ACRegisterCapture			100%
mac_db_GetRDCFilename	100%		
mac_db_IASUpdateParm			100%
mac_db_Initialize	90%		10%
mac_db_MetaDataGetAScene			100%
mac_db_MetaDataGetBandsPresent			100%
mac_db_MetaDataGetSubIntv			100%
mac_db_RegL0RPID	100%		
mac_db_RollbackL0R	100%		
mac_db_UnregL0RPID	100%		
mac_ExamLPSJournal			100%
mac_FilterMsg			100%
mac_GenQAReport			100%
mac_IngestIASParms			100%
mac_LPS	90%		10%
mac_MainAbortL0R	100%		
mac_MainActivateChildProcesses	100%		
mac_MainCleanupL0R	100%		
mac_MainInitL0R	100%		
mac_MainRollbackL0R	100%		
mac_MainShutdownL0R	100%		
mac_MainShutdownLPS	100%		
mac_MainStartL0R	100%		
mac_MainStopL0R	100%		
mac_MainWaitForL0R	100%		
mac_MetaDataGen			100%
mac_MetaDataGenFileHeadDesc			100%
mac_MetaDataGenScene			100%
mac_MetaDataGenSubIntv			100%
mac_MetaDataWriteAScene			100%

mac_MetaDataWriteSubIntv			100%

Table C-3: MACS Units-to-Builds Mapping (2 of 2)

	B1	B2	B3
mac_OpsMsg			100%
mac_ui_ContSchedule			100%
mac_ui_DANTransState			100%
mac_ui_DataRcvSum			100%
mac_ui_DeleteFileSet			100%
mac_ui_ExamLPSJournal			100%
mac_ui_FileTransSum			100%
mac_ui_IngestIASParms			100%
mac_ui_Level0RQA			100%
mac_ui_LPSConfig		100%	
mac_ui_LPSParms		100%	
mac_ui_LPSQA			100%
mac_ui_LPSThres			100%
mac_ui_MainShutdown			100%
mac_ui_OpsMsg			100%
mac_ui_ResendDAN			100%
mac_ui_RetainFileSet			100%
mac_ui_SendData			100%
mac_ui_StartBackup			100%
mac_ui_StartCapture			100%
mac_ui_StartL0R			100%
mac_ui_StartRestage			100%
mac_ui_StartStopAutoCapture			100%
mac_ui_StartStopDDNServer			100%
mac_ui_StopBackup			100%
mac_ui_StopCapture			100%
mac_ui_StopRestage			100%

Table C-4: RDCS Units-to-Builds Mapping

	B1	B2	B3
rdc_CalcAcctInfo	100%		
rdc_ConnectToDevice	100%		
rdc_db_WriteAcctToDb		100%	
rdc_db_WriteOnLineFlag	100%		
rdc_DeIsolateProcess		100%	
rdc_DeleteRDCFiles		100%	
rdc_GenDataRcvSumReport			100%
rdc_GenLabel			100%
rdc_Init	80%	20%	
rdc_IsolateProcess		100%	
rdc_Main	100%		
rdc_MainCapture	100%		
rdc_PrintLabel			100%
rdc_ResetDevice	100%		
rdc_RestageCptr			100%
rdc_ResumeProcess		100%	
rdc_Save			100%
rdc_SetOnLineFlag		100%	
rdc_ShutDownRDC	100%		
rdc_StopSaveRestage			100%
rdc_SuspendProcess		100%	
rdc_TermRestageSig			100%
rdc_TermSaveSig			100%
rdc_TestData			100%
rdc_TestDataTrans			100%
rdc_UpdateDb		100%	
rdc_UpdRDCAcct		100%	
rdc_WritetoAcctFile		100%	

Table C-5: RDPS Units-to-Builds Mapping (1 of 2)

	B1	B2	B3
fs_align_frames_n_output	100%		
fs_frame_sync	100%		
fs_get_stats	100%		
fs_initialize	100%		
fs_match_fsp	100%		
fs_match_fsp_slip	100%		
fs_terminate	100%		
rdp_BCHBuildMsnQuadTable	100%		
rdp_BCHCorrectBitsMsn	100%		
rdp_BCHCorrectBitsPtr	100%		
rdp_BCHDecode	100%		
rdp_BCHMsnCalcSyndromes	100%		
rdp_BCHMsnChienSearch	100%		
rdp_BCHMsnDecTree	100%		
rdp_BCHMsnDivide	100%		
rdp_BCHPtrCalcSyndromes	100%		
rdp_BCHPtrChienSearch	100%		
rdp_BCHPtrDecTree	100%		
rdp_BCHPtrDivide	100%		
rdp_BCHReduceToQuadMsn	100%		
rdp_BCHReduceToQuadPtr	100%		
rdp_BCHTransposeCadu	100%		
rdp_CRCCheck	100%		
rdp_CRCCheckSum	100%		
rdp_CRCGenTable	100%		
rdp_db_GetThresholds		100%	
rdp_db_GetThresholds			100%
rdp_db_PutRDPAcctInfo	100%		
rdp_Main	100%		
rdp_MainExtractCADU	100%		
rdp_MainFSync	100%		
rdp_MainGenerateOutput	100%		
rdp_MainInit	90%		10%
rdp_MainObtainData	100%		
rdp_MainSetVCIDAnnotations	100%		

Table C-5: RDPS Units-to-Builds Mapping (2 of 2)

	B1	B2	B3
rdp_MainShutdown	90%		10%
rdp_MainStoreFailedCADUs	100%		
rdp_MainTranToShared	100%		
rdp_MainValidateCADU	100%		
rdp_RSCheck	100%		

Table C-6: MFPS Units-to-Builds Mapping (1 of 2)

	B1	B2	B3
mfp_AlignBands		100%	
mfp_CalL0rExtract		100%	
mfp_CalWriteFile		100%	
mfp_ChckSplitMnf		100%	
mfp_compareEol	100%		
mfp_CondenseDataGrp	100%		
mfp_db_GetParms		100%	
mfp_db_GetThres			100%
mfp_db_InsertSubIntv	100%		
mfp_db_InsertSubQa	100%		
mfp_db_UpdateSubIntv	100%		
mfp_Deint		100%	
mfp_ExtractMnf	100%		
mfp_FillBand6		100%	
mfp_FillMostBands		100%	
mfp_FindMjfEol	100%		
mfp_FindMjfSync	100%		
mfp_L0RFilesGen	100%		
mfp_Main	70%	30%	
mfp_MainAdd2Set	100%		
mfp_MainBandGen		100%	
mfp_MainCheckTcFrames	100%		
mfp_MainChkMissing	100%		
mfp_MainChkSeq	100%		
mfp_MainChkSeqMjf	100%		

Table C-6: MFPS Units-to-Builds Mapping (2 of 2)

	B1	B2	B3
mfp_MainCleanup	60%	30%	10%
mfp_MainColVcduQA	100%		
mfp_MainCompScanDir	100%		
mfp_MainDetermineSub	100%		
mfp_MainDetermineTimeRange	100%		
mfp_MainEstimateTime	100%		
mfp_MainExtractTime	100%		
mfp_MainFillMissMjfs		100%	
mfp_MainFindMjfStart	100%		
mfp_MainGenSubIntv	100%		
mfp_MainGetAvInfo	100%		
mfp_MainGroupTC	100%		
mfp_MainIdentifyMjfSet	100%		
mfp_MainInit	60%	30%	10%
mfp_MainInitVcduSets	100%		
mfp_MainMjfTime	100%		
mfp_MainPcdExtract		100%	
mfp_MainPcdStatusProc		100%	
mfp_MainQACalcSub	100%		
mfp_MainQASubGen	80%		20%
mfp_MainQAThrTest			100%
mfp_MainQAZeroData	100%		
mfp_MainStatusExtract		100%	
mfp_MainTCMnfSync	100%		
mfp_MainValidateMjf	100%		
mfp_MainValidateTime	100%		
mfp_MainValVcidChg	100%		
mfp_MainVerifySpacecraftId	100%		
mfp_MscdL0rExtract	100%		
mfp_MscdWriteFile	100%		
mfp_VerifyMjf	100%		

Table C-7: PCDS Units-to-Builds Mapping (1 of 2)

	B1	B2	B3
pcd_db_GetFirstWrsScene		100%	
pcd_db_GetNextWrsScene		100%	
pcd_db_GetPrevWrsScene		100%	
pcd_db_GetValidParms		100%	
pcd_db_GetValidSceneParms		100%	
pcd_db_GetValidThres			100%
pcd_db_ReportSceneInfo		100%	
pcd_db_StoreAcctInfo		100%	
pcd_db_StoreBandsPresent			100%
pcd_LagrangeInt		100%	
pcd_Main		80%	20%
pcd_MainAcceptMinorFrames		100%	
pcd_MainAdjustTime		100%	
pcd_MainAttitudeInt		100%	
pcd_MainBuildCycle		100%	
pcd_MainBuildMajorFrames		100%	
pcd_MainBuildMinorFrames		100%	
pcd_MainCheckDataPoints		100%	
pcd_MainCleanUp		80%	20%
pcd_MainComputeHds		100%	
pcd_MainComputeLat		100%	
pcd_MainComputePosition		100%	
pcd_MainConstructCycles		100%	
pcd_MainCreatePcdFile		100%	
pcd_MainDetermineMissingWords		100%	
pcd_MainDetermineOrbitNum		100%	
pcd_MainDeterminePcdWord		100%	
pcd_MainDetermineScenes		100%	
pcd_MainDetSceneDescription		100%	
pcd_MainEphemerisInt		100%	
pcd_MainEstimateCycleTime		100%	
pcd_MainEstimateMissingCycles		100%	
pcd_MainEtmToGci		100%	
pcd_MainEvalMnfQuality		100%	

pcd_MainExtractCycleInfo			100%

Table C-7: PCDS Units-to-Builds Mapping (2 of 2)

	B1	B2	B3
pcd_MainExtractSceneParms		100%	
pcd_MainExtractWords		100%	
pcd_MainFillMajorFrame		100%	
pcd_MainFillMultiCycles		100%	
pcd_MainFillPcdCycle		100%	
pcd_MainFormatPcdCycle		100%	
pcd_MainFormatWords		100%	
pcd_MainInit		80%	20%
pcd_MainLocateSyncPatterns		100%	
pcd_MainPerformMajorityVote		100%	
pcd_MainReportScenes		100%	
pcd_MainSunAzimuthElev		100%	
pcd_MainSunPos		100%	
pcd_MainUpdateSubIntv		100%	
pcd_MainUpdateSubIntvStats		100%	
pcd_MainVerifyCycle		100%	
pcd_MainVerifyCycleTime		100%	
pcd_MainWriteCycleToFile		100%	

Table C-8: IDPS Units-to-Builds Mapping

	B1	B2	B3
idp_ACCA		100%	
idp_ACCAAssessScene		100%	
idp_ACCAInit		100%	
idp_ACCASceneCalc		100%	
idp_ACCAShutdown		100%	
idp_Band		100%	
idp_BandAppend		100%	
idp_BandClose		100%	
idp_BandCreFiles		100%	
idp_BandDetSubIntv		100%	
idp_BandEndOfScene		100%	
idp_BandEndPartial		100%	
idp_BandFileDelete		100%	
idp_BandFileWrite		100%	
idp_BandFillFile		100%	
idp_BandFindScanNum		100%	
idp_BandFindScene		100%	
idp_BandInit		100%	
idp_BandReadMF		100%	
idp_BandSceneTimes		100%	
idp_BandStartPartial		100%	
idp_BandStatusInfo		100%	
idp_Browse		100%	
idp_BrowseCreateFile		100%	
idp_BrowseInit		100%	
idp_BrowseSceneProc		100%	
idp_BrowseShutdown		100%	
idp_BrowseSubs		100%	
idp_BrowseWave		100%	
idp_ChildFindRecord		100%	
idp_ChildInit		100%	
idp_ChildShutdown		100%	
idp_db_BandUpdate		100%	
idp_db_GetFillValue		100%	
idp_db_GetIDPParms		100%	
idp_db_InsertScores		100%	
idp_Main		100%	
idp_MainInit		100%	
idp_MainProcessChildSignal		100%	
idp_MainShutdown		100%	

Table C-9: LDTS Units-to-Builds Mapping

	B1	B2	B3
ldt_CheckTimeouts	100%		
ldt_CreateDAN	100%		
ldt_db_AccDANXferState		100%	
ldt_db_CreateDANInfo	100%		
ldt_db_ExtrDANStruct	100%		
ldt_db_GenftsReport			100%
ldt_db_GetContactFileNames			100%
ldt_db_GetIngestedFiles			100%
ldt_db_GetRetentionState			100%
ldt_db_GetServerInfo		100%	
ldt_db_GetSubintv	100%		
ldt_db_GetSuspDANs			100%
ldt_db_GetTimedOutDANs			100%
ldt_db_InsStateInfo		100%	
ldt_db_SetLastXmitTime			100%
ldt_db_SetTimeout			100%
ldt_db_UpdRetentionState			100%
ldt_db_UpdSuspState			100%
ldt_db_verifyLongDDN		100%	
ldt_db_verifyShortDDN		100%	
ldt_DeleteFiles			100%
ldt_delRemoveFiles			100%
ldt_do_action		100%	
ldt_GenFTS			100%
ldt_GenftsDiskUsage			100%
ldt_input_defaults		100%	
ldt_RcvDaa		100%	
ldt_RcvDDN		100%	
ldt_RetainFiles			100%
ldt_RsndSuspDANs			100%
ldt_SendDAN		100%	
ldt_sendDDA		100%	
ldt_socket_response		100%	
ldt_start_client_n_clock		100%	
ldt_write_dan_info	100%		

Table C-10: Analysis Tools Units-to-Builds Mapping

	B1	B2	B3
Input File Dump (Sync Dump)	100%		
Shared Memory Dump	100%		
RDPS to MFPS Simulator	100%		
MFPS to PCDS Simulator		100%	
MFPS to IDPS Simulator		100%	
Database Table Dump	100%		
MSCD File Dump	100%		
Calibration File Dump		100%	
PCD File Dump		100%	
Band File Dump		100%	
Browse File Dump		100%	
Metadata File Dump			100%
LP DAAC Simulator/DESIM		100%	